



## **The XXX Summer Transportation Institute - A Novel Approach to Engaging Minority Students in US Department of Transportation Summer Program for Careers in Transportation**

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Dr. Joseph Arumala is a Professor in the Construction Management Technology Program, University of Maryland Eastern Shore and the Director of the University of Maryland Eastern Shore Summer Transportation Institute. Professor Arumala is an experienced Civil/Structural Engineer who teaches Statics, Strength of Materials, Structural Design, Soils and Surveying courses. He is the Faculty Advisor to the UMES Chapter of Sigma Lambda Chi, the Internal Honor Society for Construction. He is a past President of the Eastern Shore Branch of the American Society of Civil Engineers. Professor Arumala is actively involved in Community Development projects and in research into sustainable Alternative Building Materials and Renewable Alternative Energy Use in Buildings.

**Dr. Joseph Nii Dodu Dodoo, University of Maryland Eastern Shore**

Dr. Joseph D. Dodoo (co-PI): Research interest in astrophysics began in 1994 with a summer faculty internship at NASA Goddard Space Flight Center, under the auspices of Universities Space Research Association. The association continued until November 2003. The research work at NASA consisted of the application of Monte Carlo techniques to model a germanium detector for use in astrophysics studies. The study was part of the Gamma Ray Observatory program on the WIND satellite. In addition, the Monte Carlo technique was used to model the geometry of the Spectrometer for Integral (SPI) of the International Gamma Ray Astrophysics Laboratory, INTEGRAL. This project was launched in October 17, 2002. Current research activity has been in the area of Aviation Safety. In particular, the development of monitoring technologies to enable detection of unsafe behaviors in the flight deck. Have made presentations in international forums in Serbia, Japan, Spain, Australia and Ireland. Graduated with a B.Sc. (1970) degree in Physics from the University of South Bank, London, M.Sc. (1972) degree in nuclear and elementary particle physics from Bedford College, University of London, and a Ph.D. (1980) in atmospheric physics from King's College, University of London.

*The UMES Summer Transportation Institute - A Novel Approach to Engaging Minority Students in US Department of Transportation Summer Program for Careers in Transportation*

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**Abstract**

During the past ten years, the University of Maryland Eastern Shore (UMES) Summer Transportation Institute (STI), has hosted about 200 middle school students from the Lower Eastern Shore of Maryland to its campus. The Institute offers intensive STEM education, hands on activities and field trips that take them to some of the major transportation establishments in the states of Maryland, Delaware, New Jersey and Washington, DC. Instructors are drawn from the Wicomico County School System and work in partnership with faculty at UMES. The UMES STI provides awareness to the participants on transportation careers and encourages them to consider transportation-related courses of study in their higher education pursuits. Specifically the program provides opportunities for participants, comprising of minority and underserved groups on the Lower Eastern Shore of Maryland, to explore the many exciting fields in the Transportation Industry. The Institute runs an integrated program in Mathematics, Science, Communication Skills/English and Recreation as well as activities in Land, Air and Water Transportation. The Demographic Summary of participants showed that 94.6% of students completed the program, 37.5% of the students were Male, 62.5% Female and 92% of the participants were Black/African American. The participants were assigned projects and participated in regularly scheduled field trips to local transportation related facilities. The Institute was non-residential and was at no cost to selected applicants. Free lunch was provided for the period and each student who completed the program received a Casio Scientific Graphing Calculator. Parents were responsible for transporting their children to and from the UMES Campus. However, very needy students were provided transportation assistance. The program started from 8:00 am to 5:00 pm daily. Federal Highway Administration (FHWA) funded the Institute and the Maryland State Highway Administration administered the implementation and execution of the activities of the Institute. The Institute followed up a number of prior students and found some are currently in universities and others are pursuing STEM related careers. It is fair to state that participation in the Institute did play a role in the decision of these students to further their education in STEM programs. This paper covers some of the key areas of the Institute's activities including recruitment of students, daily management of the participants and tracking the status of Alumni of the Institute.

*Key words:* Summer Transportation Institute, Careers in Transportations, Field Trips, Middle School Students, STEM Programs

**Introduction**

A 2018 US Bureau of Labor Statistics<sup>1</sup> show that the percentage of African Americans employed in the Transportation and Utilities industries is 19.2% as compared with whites which total 71.7%. The dismal numbers are also the same in all areas of transportation, for all minorities including Asians and Hispanics as shown in Table 1. One component of the application material that the UMES STI required was a short essay by each student to indicate what area of the transportation industry they would like to be working at if given the opportunity. Reading through the applicants' essays, it became clear that for most, a career in transportation means driving a truck, a bus or a taxi. Clearly, this thought process must be derived from circumstances surrounding the

environment from which they are raised<sup>2,3,4,5,6,7</sup>. In 2009 President Obama announced the “Educate to Innovate” Campaign, and he made it clear that one of his goals was to expand STEM education and career opportunities for underrepresented minorities in that sector of the workforce. The President stated that “reaffirming and strengthening America’s role as the world’s engine of scientific discovery and technological innovation is essential to meeting the challenges of this century”<sup>8</sup>. Many researchers have found that students’ pre-college experiences are integral in students’ decision making regarding their decisions to major in STEM as undergraduates<sup>4</sup>. Thus among the goals of the UMES STI is to ensure that by the time the students complete the program perception will change and there will be enthusiasm for seeking college level education that leads to employment in STEM careers and the transportation industry.

	2018	Per cent of total employed				
	Total			Black/Afr.		Hispanic/
	employed	Women	White	American	Asian	Latino
Transportation and utilities	8,551	24.4	71.7	19.2	5.5	18.3
Transportation and warehousing	7,207	24.9	69.1	21.1	5.9	19.7
Air transportation	635	42.9	71.6	17.7	6.7	15
Rail transportation	224	7.2	84.5	11.4	2.5	9.7
Water transportation	87	25.1	85.4	9.5	3.7	15.6
Truck transportation	1,985	12.5	78.1	15.6	3.3	19.8
Bus service and urban transit	576	36.4	55.9	35.6	4.9	19.9
Taxi and limousine service	689	18.1	48.1	30.2	16.9	18.5
Pipeline transportation	64	7.5	93.9	5.1	0.5	20
Scenic and sightseeing transportation	38	-	-	-	-	-
Services incidental to transportation	850	25.8	71.9	18	6	22
Postal Service	619	44.6	60.2	28.6	6.4	11.9
Couriers and messengers	807	23.1	68.3	22.1	5.3	19.7
Warehousing and storage	634	31.5	68.7	21.8	4.5	34.3

Table 1. 2018 data showing percentages of employment in the transportation and utilities industry for all races in the US [US Bureau of Labor Statistics, 2018]

**The National Summer Transportation Institute Program.**

The National Summer Program is funded by the Federal Highway Administration (FHWA) and sponsored by States’ Department of Transportation (DOT) and/or State Highway Administration (SHA). Established in 1998, the program is designed to promote awareness of science, technology, engineering and math (STEM) educational and career opportunities among disadvantaged and at-risk middle and high school students around the country. The primary objective of the National Summer Transportation Institute (NSTI) program is to provide awareness to middle and high school students about transportation careers and encourage them to consider transportation-related

courses of study in their higher education pursuits. Performance agencies consist of accredited colleges, community colleges and universities.

### **Some National Summer Transportation Programs**

Some of the Summer Transportation Programs in the country include Morgan State University National Transportation Center Summer Transportation Institute which is designed to encourage high school students to pursue careers in transportation, The National Summer Transportation Institute California State University, Los Angeles High School Program offers a no cost program, designed to help participants with their educational and career decisions and is offered by the College of Engineering, Computer Science, and Technology at Cal State LA, The Mineta Transportation Institute, Summer Transportation Institute for high school students who live in the San Jose, California area, the Vermont Tech National Summer Transportation Institute (NSTI) which is a free program held on a college campus in Vermont for students entering 10th, 11th, or 12th grades, as well as a day-camp for middle school students, the Delaware State University Summer Transportation Program and the University of Maryland Eastern Shore Summer Transportation Program.

### **The University of Maryland Eastern Shore Summer Transportation Institute (UMES STI)**

The Summer Transportation Institute provides awareness to high school students on transportation careers and encourages them to consider transportation-related courses of study in their higher educational pursuits. Specifically, the UMES Summer Transportation Institute seeks to create awareness and stimulate interest among middle school students on the Lower Eastern Shore of Maryland about the vast transportation and science, technology, mathematics and engineering (STEM) related careers available and provide them with the opportunities to explore many exciting fields in the Transportation and STEM Industry through field trips and hands on activities. The Institute's activities cover two general programs: Academic and Enhancement Programs. The Academic Program exposes the participants to various modes of transportation: land, air, and water and aspects of transportation safety and covers various transportation careers, education and training requirements. The Enhancement Program exposes participants to methods and activities, which improve study habits, critical thinking, promote academic achievement and foster self-awareness through emphasis on STEM fields and careers. Students are exposed to daily activities and studies in English, Mathematics and Science to prepare them to sit for the Scholastic Aptitude Test (SAT), join STEM programs and activities in their schools and stress the need to consider pursuing STEM programs in college

The Institute is non-residential and the daily activities generally run from 8:00 a.m. to 5:00 p.m. and there are field trips to area transportation facilities. The Institute is scheduled in June/July of every year at the end of the school year. Participants are provided lunch for the period and each student that completes the program receives a graphing calculator. Students are responsible for their transportation arrangements. However, limited transportation service was made available for needy participants. The Institute's activities are well designed and coordinated and are conducted by experienced teachers and professionals. Selected students therefore benefit immensely from the Institute's activities. Parents, Guardians, and School Counselors are urged to encourage their children, wards and advisees to apply. Minority and female students are strongly encouraged to apply.

## **Program Administration**

### **Recruitment and Student Selection Procedures**

The Project Team uses the following plans to recruit students for the Institute: visitation to schools, youth groups and churches, Newspaper & Newsletter publications, emails and letters, Personal contacts/Word of Mouth, Town Hall Meetings and Flyers. The Institute also puts up displays at local STEM related competitions and workshops. In addition, recruitment materials are mailed to middle schools, parents, individuals, and alumni of the Institute. Also a webpage has been designed to provide needed information to schools, students and the general public. The webpage has links to related sites. The webpage is [www.umes.edu/UMESSTI](http://www.umes.edu/UMESSTI).

### **Selection Committee**

Institute participants are selected by a Selection Committee made up of the Director, two STEM specialists from UMES and two middle School Teachers. The committee uses several factors including the following for the selection process:

1. Students who are in middle school (Grades 6-8)
2. Students having a minimum cumulative grade point average of 2.0 on a 4.0 scale.
3. Current marking term results
4. Students having an expressed interest in engineering, science, transportation, or technology careers.
5. Students who have submitted at least one letter of recommendation from a teacher or a guidance counselor.
6. Students who have submitted a written one-page Essay regarding his/her reasons for wanting to participate in the program and how the STI can assist in meeting his/her career goals.

### **Staffing Requirements**

The Staff and Teachers of the Institute are a Project Director, an Aviation and Engineering Expert, English, Mathematics, and Science Teachers, a Sports Instructor and two undergraduate Student Assistants.

The academic program consisted of written communication and critical thinking components interweaved with transportation activities and studies, English, Mathematics, Science and Sports sessions. The English, Mathematics and Science studies were geared towards preparation of the students for taking standardized tests. The typical lesson plans for each module are shown below:

### **English/Communication**

The objectives were to provide students with an opportunity to read complex informational text related to the transportation industry. The goal is to develop and improve the strategy of Close Reading as recommended by the College and Career Ready Standards. To be able to understand the rudimentary components of Communication and express themselves in written form in a variety of styles-including essay, narrative, lyrical, and multimedia. Students presented their projects in the form of a multimedia presentation. They were able to research information for accuracy for the informational writing that was done. Those who presented orally were encouraged to be specific and clear to assist the audience in being able to have a more precise understanding of the text.

## Mathematics

The following were the mathematics goals for the students:

1. Teach them how mathematics connects to transportation including the rates at which objects travel and graphing those rates.
2. Have the students use their graphing calculators and build an understanding of the basic uses for their graphing calculator.
3. Have them complete STEM challenges that had them cooperatively working with each other.

Through these lessons the students built an understanding of mathematics and the fact the mathematics does connect to almost everything in life, including transportation. On the first day of the STI camp, students took a pre-assessment and the average score of this pre-assessment was a 45%.

On the last day of camp, the students took a post assessment and almost all of their post assessments showed growth. By the end of the camp every student had achieved a 70% or higher on the post assessment. Using their pre-assessment mean score of 45%, it is believed that this is a satisfactory growth for the duration of the camp.

## Science

Through a series of lessons and mini activities, students were introduced to Newton's three laws of motion and related terms such as mass, inertia, gravity, acceleration, speed, force and friction. They applied these principles to movement or motion and how they relate to a variety of forms of transportation. For each lesson, a variety of class demonstrations and PowerPoint presentations were used to explain, show and relate concepts of the laws to transportation. Each day, students had an opportunity to apply their knowledge of learned concepts by completing activities in small cooperative groups. Students completed a pre and post assessment to demonstrate what they already know and how much they've learned at the end. Students had a culminating activity of presentations to their parents to demonstrate what they have learned. Figure 1 shows a typical project in the Science Sessions.



Figure 1 shows a Plastic Bottle Rocket (L) and its launching (R)

### **Visits by SHA & FHWA Officials**

From time to time Federal Highway and State Highway Officials pay a visit to the Institute. During such visits, the Officials meet the students, sitting-in in their classes and observing their participations in Transportation activities. They also meet with the Institute's Administrators to discuss challenges to the program. The details of the last visit were as follows: Ms. Shabnam Isadi, Title VI Manager, Maryland State Highway Administration, Mr. Olufemi Akanni, DOT Executive Assistant I/Title VI Compliance Officer, Office of Equal Opportunity, MDOT, State Highway Administration, Mr. Francisco Edwin Gonzalez, Civil Rights Specialist, FHWA Maryland and Delaware Divisions and Mr. Dennis K. Jones, Administrative Specialist, Federal Highway Administration visited the UMES STI on Thursday, June, 27, 2019. They met with the Institute staff and interacted with the student participants.

### **Enhancement Program**

The Enhancement Program activities addressed land, air and water transportation systems. The activities included hands-on components and field trips. The following areas were covered:

#### **Land Transportation**

##### **Highways – Road Construction**

The students were introduced to highway and bridge construction with highlights of students performing the Standard Proctor Test, which is used to control the strength of road bases, and measuring elevation using the automatic level. They were shown the typical cross-section of a road with typical components of sub-grade, sub-base, base and the riding surface. Figure 2 shows a soil sample from the Standard Proctor Compaction Test.



**Figure 2 Display of an Extruded Soil Sample from a Standard Proctor Compaction Test**

## Surveying

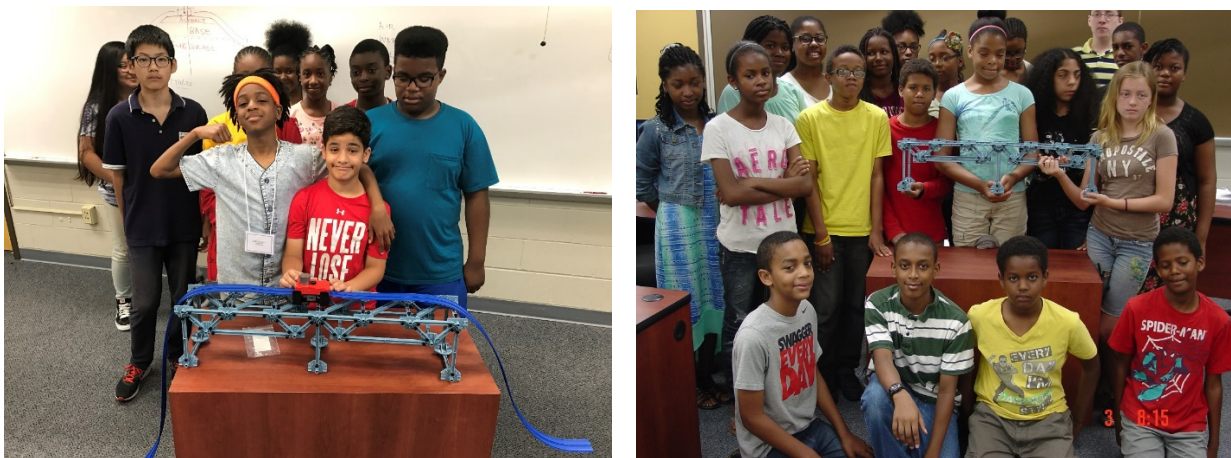
The students used the Automatic Level and Level Rod to measure elevations. Elevations are important in highway construction. A road pavement must be built at predesigned elevations (heights) above the mean sea level to insure optimum performance. Figure 3 shows the students using the Automatic Level and measuring distance with the aid of Range Poles and a Tape.



**Figure 3** Students using an Automatic Level (L) and Range Rods and a Tape (R)

## Bridges

The students used the West Point Bridge software to simulate the construction of a bridge over a river. The students built and tested the bridge. When some truss members failed during the load testing, they were able to go back to the drawing board and strengthen those members that failed. They also built model Truss Bridges. Figure 4 shows the model Truss Bridges



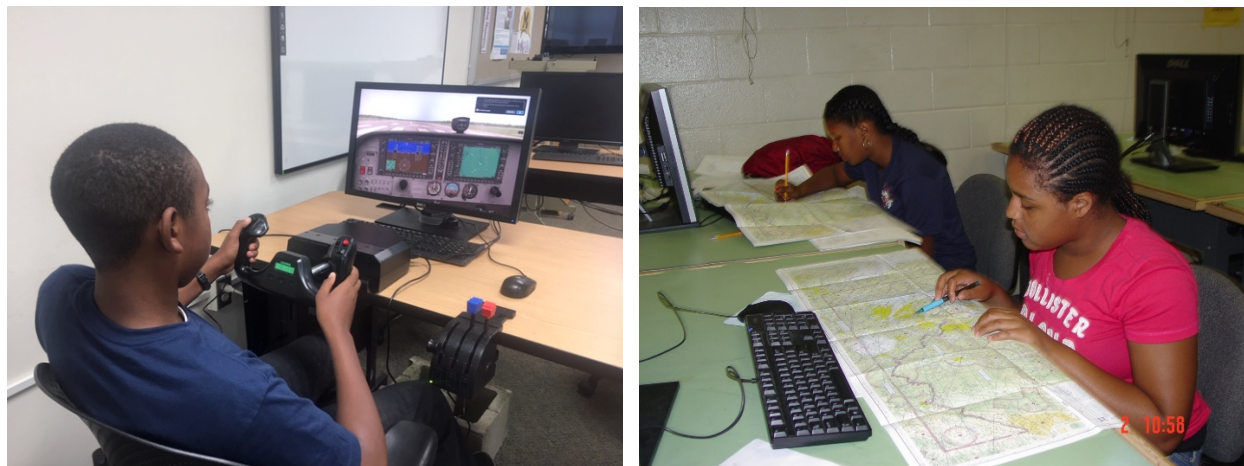
**Figure 4** The Model Truss Bridge

## Air Transportation

Students were introduced to the fundamentals of flight using standard teaching modules but simplified to cater to the class. Students were provided with the current Maryland Aviation charts and made to record the coordinates of several locations on the chart. They were also able to plan a



cross-country trip between Salisbury and Cumberland using standard plotters. Details such as ground speed computation and wind correction were excluded. Five X-Plane II flight simulator stations served to provide modicum flight experience. Students were able to fly a pattern course around a simulated Salisbury Ocean City Wicomico County Airport. Demonstration flight with a drone was conducted inside the confines of the teaching laboratory. Figure 5 shows some Air Transportation Activities



**Figure 5 STI Participants using the X-Plane II Flight Simulator (L) and Flight Charts (R)**

### **Water Transportation**

The water transportation studies were yet another major turning point in the students' experience. During a ferry trip from Lewes, Delaware to Cape May, New Jersey the students were given an assignment to calculate the average speed of the ferry for the trip both outbound and inbound. They used the timer on their smart phones to measure the time from the initial movement of the ferry to final docking. Given the known distance between the two ports the students were able to calculate the average speed of the ferry in each direction. They were able to explain the difference in the two values as due to either water current and or wind direction.

### **Field Trips**

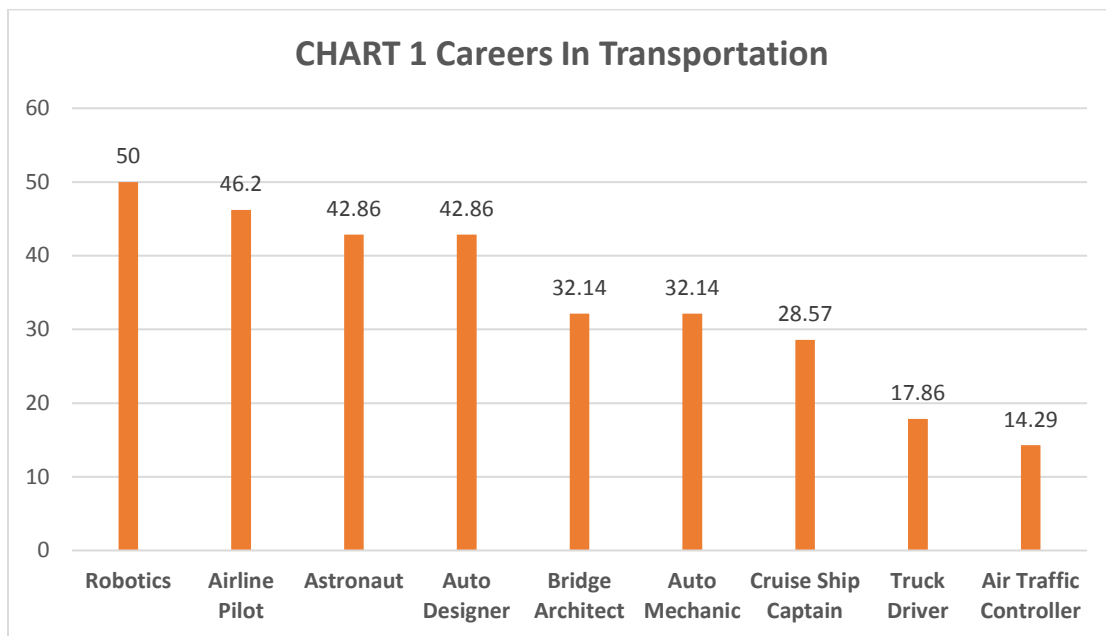
Field Trips were planned for each Summer Institute. Some of the field trips made over the years included the Baltimore and Ohio Train Museum, Baltimore Port, Baltimore Washington International Airport and the National Space Museum in Washington DC. The last field trips made were to the Cape May Lewes Ferry and the National Air Station Wildwood Aviation Museum in Cape May County, New Jersey. This visit provided a unique opportunity for the students to learn about different aircrafts and the service ceiling for each one. The trip also provided experience in transportation over a vast expanse of water - many of them for the first time. Apart from the information provided before each field trip, an official from each organization was contacted to speak to the students and to provide a guided tour of the facilities. After each field trip, there was a reflection session where the students discussed their experiences and the lessons learnt. Figure 6 shows students in a field Trip to the Cape May Ferry and the Wildwood Aviation Museum



**Figure 6 Students on the Cape May Ferry (L) and in the Wildwood Aviation Museum (R)**

### Questionnaires and Exit Surveys

There were Questionnaires completed by the students every week on the activities of the Institute on each Teacher and every activity. An exit survey is completed by each participant. The results of these in addition to contributions from the Teachers and Instructors were used to improve the activities of the Institute. Section 5 of the Exit Survey is on Careers in Transportation. The average results for 2018 and 2019 are shown in Chart 1. It shows Robotics is the most favored career.



### Highlights

At the end of the session the students were given a quiz to test their overall understanding of the lessons learned during the period of the summer transportation institute. The results were quite satisfactory with an average score of 85%.

### Follow-up Survey of Participants

The UMES Summer Transportation Institute was designed to attract middle school students to the transportation industry. It therefore seeks to track the academic performances and interests of

the alumni of the Institute by keeping relevant data as they move into high school and eventually entry into college and the workforce. Base data was collected through the application and selection process. At the end of each summer session an exit survey was administered on the participants to determine whether their interest was still in the transportation industry. Thereafter, it is planned that an annual survey will be sent out to alumni to find out if their interests is still in the transportation industry or other STEM related careers. Preliminary information received by the Institute is that many of the students have graduated from college and are working in STEM related careers.

### **Evaluations**

The participant evaluations of the Institute's activities were generally widespread. However, the overall evaluations were good.

### **Orientation and Closing Awards Programs**

The Summer Transportation Institute's Opening Ceremony starts at 9.00 a.m. on the first day with opening activities, which include the sharing of information about the program with parents and guardians with all program workers (Teachers and Student Assistants) in attendance. The Director welcomes the student participants and their parents/guardians and give a brief overview of the Institute's activities. A formal introduction of students, parents/guardians, and Institute's staff and faculty followed. Typically, the schedule for the program was then distributed and the Director went over it, highlighting the activities for each day for the duration of the Summer Institute. The Director answered questions about the schedule. Daily transportation was a concern for some parents. The opening ceremony lasted for one hour after which the regular activities went on as scheduled. The Closing Ceremony is on the last Friday of the Institute. The students made presentations on what they have learnt in the Institute to Parents and Guardians. Following this, the participants were presented with certificates of attendance and a package including a scientific calculator. Trophy Awards are made to the best students in the following categories: Overall Best Student, Transportation, Mathematics, Science, Communication, and Sports. A Trophy Award was also made to the Best Teacher elected by the STI participants. Speakers including university officials and professional engineers and scientists were invited to speak to the students during these ceremonies. Figure 7 shows a closing ceremony photograph with Parents and a Guest Speaker.



**Figure 7 Closing Ceremony with Parents (L) and a Closing Ceremony Guest Speaker (R)**

**Social Media.**

A webpage and recently a Facebook page have been set up for the Program

**Alumni – Professional Progression**

About 200 hundred middle school students from the lower Eastern Shore of Maryland have passed through the UMES Summer Transportation Institute. Some of them have gone through high school and gone onto college. Some have graduated from college with degrees in engineering, business and others are undergraduate students in STEM-related programs, Business, Kinesiology and Fine Arts.

**Challenges**

The funding for the Institute’s activities comes from Federal Highway Administration (FHWA). The grant is administered by the Maryland State Highway Administration. The funding is made available for few weeks in June. This makes it difficult to plan and administer the program efficiently.

**Program Demographic Summary (2010-2019)\***

Total Number Students who were Admitted = 186

Total Number of Students who completed the Program = 177

Percentage of students completing the Program = 94.62%

Total Number of Male Participants = 66

Total Number of Female Participants = 110

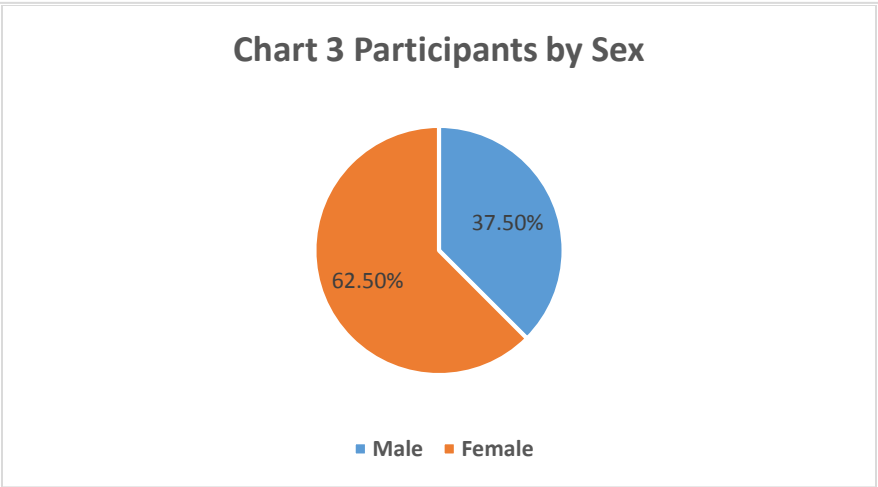
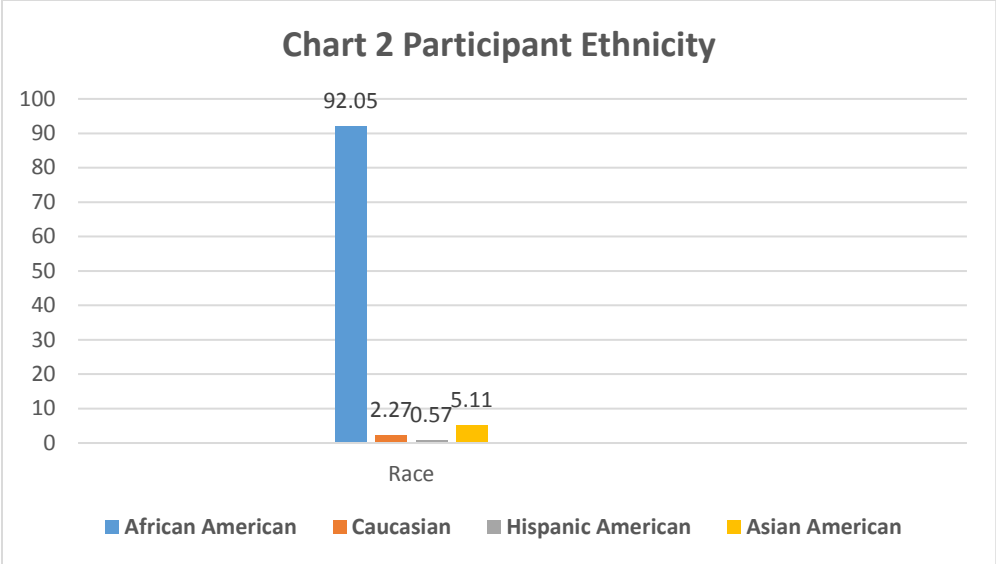
Percentage of male students completing the Program = 37.5%

Percentage of female students completing the Program = 62.5% See Chart 3 below.

<b>Ethnicity**</b>	<b>Number of students</b>	<b>Percentage of Students</b>
Black/African American	162	92.05
Caucasian	4	2.27
Hispanic American	1	0.57
Asian American	9	5.11

*\*Does not include data for 2011*

*\*\* See Chart 2 below.*



**Conclusion**

During the past ten years, the UMES Summer Transportation Institute has hosted about 200 middle school students. It offered them intensive STEM education, hands on activities and field trips that took them to some of the major transportation establishments in the states of Maryland, Delaware, New Jersey and Washington, DC. Instructors were drawn from the County School System and worked in partnership with university faculty members. The UMES STI provided awareness to the participants on transportation and STEM careers and encouraged them to consider transportation-related courses of study in their higher educational pursuits. The program provided opportunities for participants, comprising of minority and underserved groups on the Lower Eastern Shore of Maryland, to explore the many exciting fields in the Transportation Industry. The Institute provided an integrated program in Mathematics, Science, Communication Skills/English and Recreation as well as activities in Land, Air and Water Transportation. The Demographic Summary of participants showed that 94.6% of students completed the program, 37.5% of the students were Male and 62.5% were Female and 92% of the participants were Black/African American. The participants were assigned projects and participated in scheduled field trips to local transportation related facilities. The Institute was non-residential and was at no cost to selected applicants. Free lunch was provided for the period and each student received a Scientific Graphing

Calculator. Parents were responsible for transporting their children to and from the university Campus. However, very needy students were provided transportation assistance. Federal Highway Administration (FHWA) funded the Institute and the Maryland State Highway Administration monitored the implementation and execution of the activities of the Institute. Trophies were awarded to six outstanding students and an outstanding Teacher every summer Institute. The Institute has followed the educational progress of a number of prior students and found some have graduated from college are currently working in STEM careers, and others in universities pursuing STEM related programs. It is fair to state that participation in the Institute did play an important role in the decision of these students to further their education in STEM programs. This paper covered some of the key areas of the Institute's activities including recruitment of students, daily management of the participants and tracking the status of Alumni of the Institute.

### **Recommendations for Starting a Summer Transportation Program**

For faculty who are interested in starting a summer transportation program, here are some suggestions for initiating the process:

1. Work with the state Department of Transportation or State Highway Administration to apply for a Federal Highway Administration (FHWA) Summer Transportation grant. The grants are two categories: middle school (grades 6-8) and high school (grades 9-12). The grants can also be residential or non-residential.
2. Work with local county schools to recruit Teachers and student participants for the program.
3. Identify experts, workshops and laboratories on campus that will facilitate the execution of the activities of the program and
4. Work with the university administration especially the Sponsored Research unit and the Comptroller's office for the internal processing of your grant proposal.

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